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10/807,413	03/24/2004	Taichiroo Konno	035532-0140	3864

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EXAMINER	
MONDT, JOHANNES P	

ART UNIT	PAPER NUMBER
3663	

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No. 10/807,413	Applicant(s) KONNO ET AL.	
	Examiner Johannes P. Mondt	Art Unit 3663	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE ____ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 February 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *3/24/04, 8/19/05*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 2/21/06 has been entered.

Information Disclosure Statement

The examiner has considered the items listed on the Information Disclosure Statements filed 3/24/04 and 8/19/05. Signed copies of Forms PTO-1449 are herewith enclosed.

Response to Amendment

Amendment first filed as After-Final Amendment on 1/23/06 has been entered following said Request for Continued Examination. In said Amendment Applicant substantially amended claims 1-23 through substantial amendment of independent claim 1. Comments on Remarks submitted with said Amendment are included below under "Response to Arguments".

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. ***Claims 1, 3, 5, 7, 9 and 18*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Jou et al (5,869,849) in view of Sasaki (5,856,682), or, in the alternative, in view of Kuo et al (US 2002/0104997 A1).

Jou et al teach a light emitting diode comprising: a semiconductor substrate 540 (col. 3, l. 54); a light-emitting region 530 including an active layer 532 provided between a first conductivity type cladding layer 533 and a second conductivity type cladding layer 531 (col. 3, l. 45-55); a transparent conductive film 570 made of a metal oxide (indium-tin-oxide or ITO: col. 4, l. 23-24) and located over the light-emitting region; a first electrode 560b (col. 4, l. 26-28) on the upper side of the transparent conductive film; a second electrode 550b (col. 4, l. 25-26) formed on the whole or a part of the bottom of the semiconductor substrate; and a (preventive) layer 520 of AlGaAs (col. 4, l. 52-55) capable to prevent exfoliation in comparison with the prior art by virtue of having a greater impurity concentration (namely: greater than 10^{18} cm^{-3}) (col. 4, l. 53-58), hence having a high carrier concentration, being made of a compound semiconductor containing at least aluminum and located between the light-emitting region 530 and the transparent conductive film 570. Applicant is reminded that the limitation “for preventing….” constitutes functional language. In reference to said limitation, intended use and other types of functional language must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the

intended use, then it meets the claim. In re Casey,152 USPQ 235 (CCPA 1967); In re Otto , 136 USPQ 458, 459 (CCPA 1963).

Jou et al do not necessarily teach the limitation "and an undoped layer or layer of low carrier concentration formed between the active layer and the second conductivity type cladding layer, wherein the undoped layer or low carrier concentration layer is a layer other than the active layer and comprises a bandgap greater than the active layer".

However, it would have been obvious to include said limitation in view of Sasaki et al, who, in a patent on an LED with an AlGaInP active layer (see for instance Example 5), hence analogous art, teach the inclusion (col. 12, l. 21-52) of an un-doped spacer layer 21 (col. 46-51) of higher band gap than the active layer 3 (because of repeated application of Vegard's Law as applied to the difference in band gap between active layer 3 and the equivalent 4 of said second conductivity type cladding layer (N.B.: $(Al_{0.3}Ga_{0.7})_{0.5}In_{0.5}P$ (active layer 3) is formed between the active layer 3 and the second conductivity type cladding layer 4 and $(Al_{0.7}Ga_{0.3})_{0.5}In_{0.5}P$ (spacer layer 21): the band gap of GaP, i.e., 2.27 eV at 300K, is less than the band gap of AlP, 2.41 eV at 300K), said un-doped layer 21 being formed between said active layer 3 and said clad layer 4 so as to reduce penetration of unwanted charge carriers from said cladding layer into the active layer.

Motivation to include the teaching by Sasaki in the invention by Jou et al derives immediately from the teaching by Sasaki of the resulting reduced dopant diffusion in the second conductivity type cladding layer into the active layer, said diffusion being

blocked by said un-doped spacer layer 21 (see col. 3, l. 8-18), this "degradation of crystallinity of the active layer and resultant formation of non-radiative centers are suppressed, making it possible to efficiently output light to the outside" (of the device) (loc.cit.).

In the alternative rejection over Jou et al in view of Kuo et al, it would have been obvious to include said limitation in view of Kuo et al, who, in a patent on an LED with an AlGaInP active layer (see "Summary of the Invention", [0011]-[0016]]), hence analogous art, teach the selection of a multiple quantum well for active layer (loc.cit.), thereby significantly increasing the light emission efficiency (see [0038]). Please note that any active layer in any light emitting diode inherently has at most a low doping concentration, as otherwise electrons and holes could not coexist. Furthermore, inherently, said multiple quantum well layer is a multi-layer of individual quantum well layers, each of these being active layers in their own right, while a single quantum well layer is surrounded both from the bottom and the top by a barrier layer of higher bandgap than that of the individual; quantum well layer (see e.g., Fukuda, "Optical Semiconductor Devices", pages 82-84). Hence the barrier layer meets the claim limitation on the claimed undoped or low carrier concentration layer formed between the active layer and the second conductivity cladding layer, while any of the individual quantum well layers meets the claim limitation on active layer.

Motivation derives directly from the higher light output efficiency achievable by selection a multiple quantum well for the active layer structure. As an immediate and inherent consequence the light emitting diode has more than one active layer, hence

has one active layer as claimed in line 3 of claim 1 by Applicant, in particular any of the active layers in the multiple quantum well except the topmost active layer, and the claimed "undoped layer or low carrier concentration layer formed between the active layer and the second conductivity type cladding layer" is met by any of the additional active layers on said one active layer.

On claim 3: the preventing layer has a thickness of a little as infinitesimally over 50 nm (col. 4, l. 53-58).

On claim 5: the transparent conductive film is made of indium tin oxide (cf. col. 4, l. 23-24).

On claim 7: the "preventing" layer is made of an arsenic compound, namely AlGaAs (a/o) (col. 4, l. 53-54).

On claim 9: the light emitting region is made of $(Al_xGa_{1-x})_yIn_{1-y}P$ (col. 3, l. 45-55).

On claim 18: this rejection is offered assuming the following interpretation of the limitation "the AsGaAs layer is formed at": "the preventing layer, wherein the preventing layer is a AlGaAs layer, said AlGaAs layer formed at...": Aside from the noted indefiniteness (see 35 USC 112 rejection included above) the further limitation as defined by claim 18 ("formed...") fails to further limit the light emitting diode but instead only limits it method of making.

2. ***Claims 2, 4, 6, 8 and 10*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Jou et al and Sasaki et al or Kuo et al as applied to claim 1 and further in view of Okazaki et al (6,495,862 B1) and Tsuda et al (US 2005/0095768 A1). As detailed above, claim 1 is unpatentable over Jou et al in view of Sasaki or Kuo et al.

Jou et al do nor Sasaki nor Kuo et al necessarily teach the further limitation defined by claim 2. However, it would have been obvious to include said further limitation because in a patent on contact layers in contact with transparent electrodes in light-emitting diodes to prevent exfoliation (abstract, Figure 1, col. 3, l. 65 – col. 5, l. 14) Okazaki et al teach, as the equivalence of GaN, AlGaAs layers as contact layers contacting p-side transparent electrodes suitable to prevent exfoliation of GaN and of AlGaAs, the selection rather depending on the constitution of the active layer (col. 13, l. 8-25). Although Okazaki et al do not specifically teach a range for the impurity concentration, impurity concentrations of 1019 cm-3 are evidently common in the art of making contact regions, as witnessed by Tsuda et al, citing a value of 1020 cm-3 for said impurity concentration ratio for a p-side GaN contact doped with Mg (see [0143]). *Motivation* to select AlGaAs in the case of the application to GaAs based light emitting diodes and the selection of an impurity concentration well over 10^{19} cm^{-3} thus is seen to involve only ordinary skills in the art. Applicant is reminded in this regard that it has been held that mere selection of known materials generally understood to be suitable to make a device, the selection of the particular material being on the basis of suitability for the intended use, would be entirely obvious. In re Leshin 125 USPQ 416.

On claim 4: the preventing layer has a thickness of a little as infinitesimally over 50 nm (col. 4, l. 53-58).

On claim 6: the transparent conductive film is made of indium tin oxide (cf. col. 4, l. 23-24).

On claim 8: the "preventing" layer is made of an arsenic compound, namely AlGaAs (a/o) (col. 4, l. 53-54).

On claim 10: the light emitting region is made of $(Al_xGa_{1-x})_yIn_{1-y}P$ (col. 3, l. 45-55).

3. ***Claims 11, 19-23*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Jou et al and Sasaki or Kuo et al as applied to claim 1 above, and further in view of Temkin et al (Journal of Applied Physics 51(6), 3269-3272 (1980)). As detailed above, claim 1 is unpatentable over Jou et al in view of Sasaki. Jou et al do nor Sasaki necessarily teach the further limitation defined by claim 11. However, the advantage of having a stoichiometric parameter x within the range of a direct band gap (x between 0 and 0.45) has long been known to be vital to having low resistance for the ohmic contact, as seen from Temkin et al (see abstract, Figure 1 and Experimental section), who thus recommend the range between 0 and 0.45 for x. *Motivation* to include the teaching of this range at least stems from the very purpose of ohmic contact regions to provide low resistance contact to the electrodes. Furthermore, considering the substantial overlap of the claimed range with the one found in the prior art by Temkin et al at the very least constitutes a prima facie case of obviousness.

On claims 19, 20 and 21: the further limitations of claims 19 and 21 fail to further limit the light emitting diode but instead only limit its method of making.

On claim 22: the transparent conductive film by Jou et al is made of indium tin oxide (ITO) (see comment in claim 1).

On claim 23: the light emitting region is made of $(Al_xGa_{1-x})_yIn_{1-y}P$ (col. 3, l. 45-55).

4. ***Claim 12*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Jou et al and Sasaki or Kuo et al applied to claim 1 above, and further in view of Okazaki et al (6,495,862 B1) and Tsuda et al (US 2005/0095768 A1). As detailed above, claim 1 is unpatentable over Jou et al in view of Sasaki or Kuo et al. Jou et al do not necessarily teach the further limitation as defined by claim 12, although Jou et al do teach an equivalence of AlGaAs to GaN as contact layers as noted above. However, it would have been obvious to include said further limitation because in a patent on contact layers in contact with transparent electrodes in light-emitting diodes to prevent exfoliation (abstract, Figure 1col. 3, l. 65 – col. 5, l. 14) Okazaki et al teach the equivalence of GaN and AlGaAs layers as contact layers contacting p-side transparent electrodes suitable to prevent exfoliation of GaN and of AlGaAs, the selection rather depending on the constitution of the active layer (col. 13, l. 8-25). Although Okazaki et al do not specifically teach a range for the impurity concentration, impurity concentrations of 10^{19} cm-3 are evidently common in the art of making contact regions, as witnessed by Tsuda et al, citing a value of 10^{20} cm-3 for said impurity concentration ratio for a p-side GaN contact doped with Mg (see [0143]). *Motivation* to select AlGaAs in the case of the application to GaAs based light emitting diodes and the selection of an impurity concentration well over 10^{19} cm^{-3} thus is seen to involve only ordinary skills in the art. Applicant is reminded in this regard that it has been held that mere selection of known materials generally understood to be suitable to make a device, the selection of the particular material being on the basis of suitability for the intended use, would be entirely obvious. In re Leshin 125 USPQ 416.

5. ***Claim 13*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Jou et al, Sasaki or Kuo et al, and Temkin et al as applied to claim 11 above, and further in view of Okazaki et al (6,495,862 B1) and Tsuda et al (US 2005/0095768 A1). As detailed above, claim 11 is unpatentable over Jou et al in view of Sasaki or Kuo et al and Temkin et al. Jou et al do nor Sasaki nor Kuo et al nor Temkin et al necessarily teach the further limitation as defined by claim 13, although Jou et al do teach an equivalence of AlGaAs to GaN as contact layers as noted above. However, it would have been obvious to include said further limitation because in a patent on contact layers in contact with transparent electrodes in light-emitting diodes to prevent exfoliation (abstract, Figure 1col. 3, l. 65 – col. 5, l. 14) Okazaki et al teach the equivalence of GaN and AlGaAs layers as contact layers contacting p-side transparent electrodes suitable to prevent exfoliation of GaN and of AlGaAs, the selection rather depending on the constitution of the active layer (col. 13, l. 8-25). Although Okazaki et al do not specifically teach a range for the impurity concentration, impurity concentrations of 10^{19} cm-3 are evidently common in the art of making contact regions, as witnessed by Tsuda et al, citing a value of 10^{20} cm-3 for said impurity concentration ratio for a p-side GaN contact doped with Mg (see [0143]). *Motivation* to select AlGaAs in the case of the application to GaAs based light emitting diodes and the selection of an impurity concentration well over 10^{19} cm^{-3} thus is seen to involve only ordinary skills in the art. Applicant is reminded in this regard that it has been held that mere selection of known materials generally understood to be suitable to make a device, the selection of the

particular material being on the basis of suitability for the intended use, would be entirely obvious. In re Leshin 125 USPQ 416.

6. ***Claims 14 and 16*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Jou et al and Sasaki or Kuo et al as applied top claim 1, and further in view of Okazaki et al (6,495,862). As detailed above, claim 1 is unpatentable over Jou et al and Sasaki or Kuo et al as applied to claim 1. Jou et al nor Sasaki nor Kuo et al necessarily teach the further limitation defined by claim 14. However, as shown by Okazaki et al the use of Mg (or Zn or C a/o) as metal dopants of a p-type contact layer for the prevention of exfoliation has long been recognized in the art of light-emitting diodes (col. 6, l. 4-40) (note AlGaAs contact layers are alternatively included in Okazaki's teaching: col. 13, l. 8-25*)*. *Motivation* to include the teaching by Okazaki et al at least derives from the success in the anneal step described in col. 6 to accomplish a high impurity concentration and a consequent strong reduction in resistivity of the ohmic contact. With regard to claim 16: the additional limitation in comparison with claim 15, namely that "C is autodoped" fails to further limit the light emitting diode as final structure but instead merely limits a making of making.

7. ***Claims 15 and 17*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Jou et al, Sasaki or Kuo et al, and Temkin et al as applied to claim 11 above, and further in view of Okazaki et al (6,495,862). As detailed above, claim 11 is unpatentable over Jou et al in view of Sasaki or Kuo et al, and Temkin et al, none necessarily teaching the further limitation defined by claim 15. However, as shown by Okazaki et al

the use of Mg (or Zn or C a/o) as metal dopants of a p-type contact layer for the prevention of exfoliation has long been recognized in the art of light-emitting diodes (col. 6, l. 4-40) (note AlGaAs contact layers are alternatively included in Okazaki's teaching: col. 13, l. 8-25*). Motivation* to include the teaching by Okazaki et al at least derives from the success in the anneal step described in col. 6 to accomplish a high impurity concentration and a consequent strong reduction in resistivity of the ohmic contact. With regard to claim 17: the additional limitation in comparison with claim 15, namely that "C is autodoped" fails to further limit the light emitting diode as final structure but instead merely limits a making of making.

Response to Arguments

Applicant's arguments filed 12/23/06 have been fully considered but they are not persuasive. In particular, while a multiple quantum well is an active layer as a whole, each individual quantum well within said multiple quantum well is an active layer as well in its own right, whereas an individual quantum well within said multiple quantum well is surrounded by barrier layers with a band gap higher than the individual quantum well. See, for instance, Fukuda, "Optical Semiconductor Devices", Wiley Series in Microwave and Optical Engineering", Kai Chang, Series Editor, John Wiley & Sons, ISBN 0-471-14959-4 (1998), pages 82-84. Therefore, the previous rejections essentially stand with the newly amended claim language included.

Furthermore, the rejection of the claims does not depend on this issue, so that there is no need to amend so as to exclude any component of a multiple quantum well, as witnessed by Sasaki (5,856,682), teaching an undoped $(Al_{0.7}Ga_{0.3})_{0.5}In_{0.5}P$ layer

between the active layer (of $(Al_{0.3}Ga_{0.7})_{0.5}In_{0.5}P$ and the upper cladding layer as in the application, for the purpose of reducing penetration of the active layer by unwanted charge carriers from the cladding layer (col. 3, lines 8-18 and Example 5 (col. 12, lines 28-52).

For reasons of completeness both sets of art rejections have been worked out in detail overleaf.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P. Mondt whose telephone number is 571-272-1919. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack W. Keith can be reached on 571-272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JPM

March 6, 2006

Patent Examiner:

Johannes Mondt (Art Unit: 3663).